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ORIGINAL ARTICLE

A case-control study on oral health-related quality of life in kidney disease patients undergoing haemodialysis

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Abstract
Objective The study aims to assess the influence of oral health status and socio-behavioural variables on oral health-related quality of life (OHRQoL) in a sample of Iranian haemodialysis (HD) patients.
Materials and methods The present case-control study included 512 patients undergoing HD and 255 healthy controls from Iran. A self-reported questionnaire was used to record socio-demographic variables. In addition, laboratory and clinical variables of each patient were extracted from clinical and patient's electronic records. A closed-ended questionnaire was framed in order to assess oral health knowledge, attitudes and behaviour of each subject. The Short Form Health Survey (SF-36) and Oral Health Impact Profile-14 (OHIP-14) were used respectively to assess general health-related quality of life (GHRQoL) and OHRQoL. All subjects were clinically examined by two trained and experienced dentists for caries by decayed, missing and filled teeth index (DMFT), dental plaque by visible plaque index (VPI), gingival status by Loe and Silness gingival index (GI) and periodontal status by community periodontal index (CPI).
Results Statistically significant differences were found between HD patients and control subjects for all oral health indices. Patients had significantly ($p<0.001$) higher mean DMFT, VPI and GI values than controls. Periodontal pockets deeper than 4 mm were more frequently diagnosed in HD patients ($p<0.001$). HD patients reported significantly poorer GHRQoL and also a higher impact of oral health (i.e. poorer OHRQoL) in comparison with the healthy controls ($p<0.01$).
Conclusions Oral health status, clinical variables, socio-behavioural factors and GHRQoL were significant predictors of OHRQoL in Iranian HD patients.
Clinical relevance The study findings support the assumption that patient-reported measures can be used to predict treatment need since the objective clinical variables were significantly related to subjective self-reported quality of life in HD patients.

Keywords Oral health-related quality of life · Dialysis · Ageing · Oral health · Iran

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Introduction

Chronic kidney disease (CKD) and end-stage renal disease (ESRD) have become worldwide public health problems [1]. Particularly in Iran, the prevalence of CKD (stages I and II) has been reported to be 10.63 % (based on urine abnormalities) and 14.53 % (based on macro- and microalbuminuria) [2]. Kidney disease patients on dialysis are more susceptible to infections because of general debilitation, depression of the

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immunologic response and masking of signs and symptoms of infection by drug therapy [3].

Poor general health conditions as observed in any chronic illnesses are often associated with poor quality of life [4], and patients on dialysis treatment are no exception [5]. It has also been reported that patients undergoing chronic dialysis treatment have a poorer quality of life than the general population [4]. The literature suggests that kidney disease and its therapy are associated with changes in teeth, oral mucosa, bone, periodontium, salivary glands, tongue, oral cavity and temporomandibular joint [6]. Furthermore, periodontitis has been found to be a reflection of inflammation and malnutrition status in haemodialyisis (HD) patients [7]. The chronic nature of kidney disease and the debilitating general health condition might also contribute to poor oral hygiene in kidney disease patients as they usually tend to neglect oral health because of their poor systemic health [8].

It is important to distinguish between clinical oral conditions and medically compromised patients' perceptions of how oral conditions affect their functioning and well-being [8]. Some studies [9–11] have evaluated the oral health-related quality of life (OHRQoL) in medically compromised patients and patients with systemic disease, but only one study was traced that has evaluated OHRQoL in HD patients [8]. However, no attempt was made to analyse the effect of oral health status and socio-behavioural variables on OHRQoL in HD patients while there is enough evidence to support the assumption that these factors influence OHRQoL [12]. Thus, the present study intended to assess the influence of oral health status and socio-behavioural variables on OHRQoL in a sample of Iranian HD patients.

Materials and methods

Patients

This case-control study was performed on two samples. The first sample included ESRD patients undergoing HD in four dialysis centres from two Iranian cities, Tehran (n=3) and Qazvin (n=1). From April 2012 to September 2012, 512 patients undergoing HD were recruited consecutively from these centres after checking for eligibility. Inclusion criteria were age older than 18 years, undergoing HD since 3 months or more and ability to read and write Persian. Patients with cognitive impairment as assessed by the Mini-Mental State Examination were excluded from this study. In order to select healthy controls, Qazvin was divided into three zones according to the Qazvin's city hall classification, and one health centre was randomly selected from each zone. All health centres had records of personal data and health information of individuals visiting those centres. Phone numbers of subjects eligible to be included in the study as controls were retrieved from these health centres, and these persons were informed about the study objectives and invited to participate. The subjects of the control group were eligible for inclusion in the study if they had no systemic diseases, had agreed to provide consent and were able to read and write Persian. Those who agreed to participate were invited to attend a dental clinic. Out of 374 invited people, 255 (68.2 %) Iranian adults attended the dental clinic.

Patients and controls were matched for age and sex by a group-matching design. The age variable was categorized into four groups, namely <30, 30–44, 45–60 and >60 years. Controls were selected randomly from the eight gender and age group combinations in the same proportion as in the patient group.

All subjects in the study gave verbal and written informed consent to their participation prior to inclusion in the study. The study procedure was approved by the Ethics Committee of Qazvin University of Medical sciences (QUMS).

Measures

Socio-demographic variables

Socio-demographic variables like age, gender, education, marital status and occupation were assessed using a self-reported questionnaire from each subject.

Laboratory variables

Patients' body mass index (BMI), dialysis duration and cause of kidney disease were extracted from clinical and electronic patient records. In addition, laboratory results that are routinely measured in HD patients such as serum albumin, haemoglobin and kt/v (a measure for dialysis efficacy) were also extracted from the records.

Oral health knowledge

Oral health knowledge was assessed using a five-item questionnaire: "Sugar is an etiological factor of dental caries; tooth decay can be prevented by using fluoridated toothpaste twice a day; gum bleeding is a sign of a periodontal disease; early occurrence of oral diseases can be diagnosed by seeking dental services; smoking cigarettes and chewing tobacco for a long time may result in oral cancer". The items were measured on a two-point scale; a score of '0' was given when the response was 'no', while a score of '1' was given when the response was 'yes'. A sum score was computed to get the total oral health knowledge (ranging from 0 to 5). Higher scores indicated better oral health knowledge.

Oral health attitude

Attitudes towards oral self-care behaviours were measured using six items on a five-point bipolar scale ranging from 1 to 5 and the summative oral health attitude score ranged from 6 to 30 with high scores representing positive attitude (α= 0.92). For example, brushing teeth every day in the future would be 1=good to 5=bad, pleasant–unpleasant, healthy–unhealthy; flossing teeth every day in the future would be good–bad, pleasant–unpleasant, healthy–unhealthy. Scores from each item were summed up to create the total attitude score.

Oral health behaviours

Participants were asked to indicate how frequently they perform oral hygiene measures. Frequency of tooth brushing was assessed using a seven-point scale (1=never, 2=less than once in a month, 3=once in a month, 4=less than once a week, 5=once a week, 6=once a day and 7=twice a day). Interdental cleaning was evaluated using a six-point scale (1=never, 2=less than a month, 3=once in a month, 4=less than once a week, 5=once a week and 6=once a day). Furthermore, participants were asked to indicate whether they are currently smokers or not. Current smokers were defined as those individuals who are currently smoking at least once a day.

General health-related quality of life (GHRQoL)

The Short Form-36 (SF-36) was used to assess the GHRQoL [13]. The SF-36 is a self-administrated and validated measure with 36 items which cover 8 dimensions [13]. The SF-36 can be summarized into two components: the Physical Component Summary (PCS) and the Mental Component Summary (MCS). Each dimension is linearly transformed into a scale of 0 to 100 with the higher score representing better quality of life. The SF-36 has been widely used across different languages including Iranian (Farsi) [14]. The Iranian version of the SF-36 has been shown to be highly valid and reliable among the general population [14] as well as kidney disease patients [15, 16].

Oral Health Impact Profile (OHIP-14)

The OHIP-14 was used to investigate OHRQoL [17]. OHIP-14 consists of 14 items categorized under 7 dimensions. The item responses are scored on a five-point Likert-type scale from 0 (never) to 4 (very often). Total OHIP-14 is computed by summing the item responses which may range from 0 to 56 with higher scores representing poorer OHRQoL. The OHIP-14 has been translated into several languages including Farsi [18]. The Iranian version of OHIP-14 was found to be a precise, valid and reliable instrument to be used among the Persian population [18].

Clinical oral variables

The oral health assessment of dialysis patients took place at dental clinics near one of the dialysis centres in Tehran and Qazvin. Healthy controls were assessed for their oral health status in a dental clinic in Qazvin. Both control and patient groups were examined by two trained and experienced dentists. The decayed, missing and filled tooth index (DMFT) [19], Loe and Silness [20] gingival index (GI), community periodontal index (CPI) [19] and the modified Quigely-Hein index visual plaque index (VPI) [21] were used to assess dental caries, gingival status, periodontal disease and plaque levels, respectively.

To assess inter-rater reliability, these trained and calibrated dentists separately examined 35 patients undergoing HD (a separate group from the main study) 2 weeks before conducting the study. Each subject was examined by the first dentist and then re-examined by the second dentist within 24 h. The intra-class correlation coefficient (ICC) with a two-way mixed-effects model was computed for DMFT, GI, CPI and VPI to assess the degree of agreement between the examiners. The results indicated that ICCs were 91, 82, 87 and 85 % for DMFT, GI, CPI and VPI, respectively. All examinations were carried out at a dental clinic under natural daylight using a plane mirror and an explorer.

Statistical analysis

Comparison between patient and healthy groups for demographic characteristics was performed using Independent *t* test (for continuous variables) and chi-square (for categorical variables). The Shapiro-Wilk test was used to assess the normality of the distributions of the variables. Oral health parameters including decayed teeth (DT), missing teeth (MT), filled teeth (FT), DMFT, GI, CPI and VPI were compared between healthy and patients groups using an analysis of covariance (ANCOVA) adjusted for age, gender and education. To investigate participants' oral health impact using OHIP-14, responses were dichotomized into two categories (i.e. impact and no impact); an impact was considered to be existent when the response for the item was either 'sometimes', 'fairly often' or 'very often'. The results were expressed as percentages and compared between healthy and patient groups using chi-square.

Univariate regression analysis was performed to identify the key factors associated with OHIP-14 score, and variables with p values <0.05 in the analyses were included in a hierarchical linear regression model by the forward stepwise

selection method. At the first step, socio-demographic variables were entered into the model, i.e. age, gender (1=male, 2=female), family income and years of education. Body mass index, the existence of diabetes (1=no, 2=yes), Kt/v, DMFT, GI, CPI and VPI were included in the model at the second step. Cognitive variables (i.e. oral health knowledge and oral health attitude) were entered in the next step. The fourth step contained oral health behaviours including brushing and flossing frequencies, smoking habits and dental attendance. At the final step, GHRQoL was entered into the model to investigate its relationship with OHRQoL. p values of <0.05 were considered statistically significant. Data analysis was carried out using SPSS for windows version 20 (IBM Corporation, Software Group, NY, USA).

Results

Mean ages of patients and control groups in this study were 57.8±17.0 and 55.7±15.9 years, respectively. The primary causes of renal disease were hypertension (41.6 %) followed by diabetes mellitus (35.5 %), and there were more males than females in both groups. The socio-demographic and clinical characteristics of patients and control groups are summarized in Table 1. No significant differences between patients and control subjects were found for socio-demographic characteristics.

It is evident from Table 2 that there were significant differences between patients and control subjects for all the clinical indices evaluated. Patients had significantly higher caries experience than controls when data were adjusted for age, gender and education (F=54.506, p<0.001). Moreover, VPI and GI values were significantly greater in patients undergoing HD compared to the control group (p<0.001). The differences remained significant when data were adjusted for age, gender and education. The values of the CPI differed significantly between the two groups. Pockets deeper than 4 mm (CPI scores 3 and 4) were more frequently diagnosed in the HD patients (p<0.001), and the percentage of healthy sextants was lower in HD patients compared to controls (p<0.001).

The distributions of responses to OHIP-14 items were compared in order to compare OHRQoL between HD patients and healthy controls. The prevalence of oral health impacts on various dimensions of quality of life for both groups is shown in Table 3. Significantly greater number of patients undergoing HD reported the impact of oral health on all the items and dimensions of OHIP-14 than the healthy controls (p<0.001).

HD patients brushed (p<0.001) their teeth less frequently and also used dental flossing (p<0.001) scarcely compared to the control subjects. Moreover, more HD patients than healthy controls were smokers (p<0.001). There was a statistically significant difference between patients and control subjects in terms of dental attendance. Healthy controls attended dental clinics more frequently compared to patients undergoing HD (p<0.01).

The GHRQoL and OHRQoL were compared between HD patients and healthy controls to test if HD affects patient-reported outcomes. It is clear from Table 4 that HD patients reported significantly lower GHRQoL (both the PCS and MCS) and also higher impact of oral health on quality of life (i.e. poorer OHRQoL) in comparison with the healthy controls (p<0.01).

According to the study objective, factors associated with OHRQoL were tested using a hierarchical linear regression analysis (Table 5). Taking into account the potential impact of socio-demographic variables, these variables were included in the first block. Higher age, lower family income and lower educational level of the HD patients were associated significantly with poor OHRQoL (p<0.01). The socio-demographic variables accounted for 52 % of the variance in OHRQoL. The BMI, diabetic patients, Kt/v, DMFT, CPI, GI and VPI significantly predicted OHRQoL in the second step of the analysis (p<0.01). The third step of the analysis indicated that cognitive variables including oral health knowledge and oral health attitude increased the predictive validity of the model by 10 % (p<0.01). Regular dental brushing, non-smoking and dental visits in the previous 6 months were predictors of better OHRQoL among HD patients. The fifth step in the regression analysis indicated that both the PCS and MCS, as measure of GHRQoL, increased the predictive validity of the model by 4 % (p<0.01).

Discussion

OHRQoL can be used to assess the success of clinical treatment and also to monitor oral health interventions across populations. To our knowledge, this is the first study to investigate the impact of socio-demographic, behavioural and clinical variables as well as GHRQoL in HD patients on their OHRQoL and determine the influence of risk factors for poor OHRQoL among these patients.

In this study, we found that Iranian patients undergoing HD had more dental caries compared to healthy controls. The mean DMFT in HD patients was found to be 20.06±11.16 which is higher than the values reported in current literature [22–24]. A potential reason for this discrepancy is that our patients were older than those in previous studies, and studies indicate that age is an important predictor for higher caries experience [25]. Moreover, ageing not only increases the risk of the DMFT but has also been observed to contribute to poor OHRQoL [26].

This study revealed that periodontal pockets deeper than 4 mm were more frequently diagnosed in HD patients compared to controls. The explanation for this finding is that the

Table 1 Demographic characteristics and clinical variables of patients and healthy samples

Variables	Haemodialysis patients (n=512)	Healthy sample (n=255)
Age (mean±SD)	57.7±17.01	55.8±15.9
Gender, *n* (%)		
Male	322 (62.9)	158 (62.0)
Female	190 (37.1)	97 (38.0)
Marital status, *n* (%)		
Single	99 (19.3)	58 (22.7)
Married	394 (77.0)	190 (74.5)
Divorced/widowed	19 (3.7)	7 (2.7)
Family income, *n* (%)		
Good	143 (27.9)	80 (31.4)
Moderate	313 (61.1)	145 (56.9)
Poor	56 (10.9)	30 (11.8)
Occupational status, *n* (%)		
Employed	169 (33.0)	168 (65.9)
Unemployed	343 (67.0)	87 (34.1)
Years of education (mean±SD)	8.00±4.21	8.15±5.86
Duration of haemodialysis (months) (mean±SD)	52.12±29.86	NA
Body mass index (BMI) (mean±SD)	24.09±4.88	NA
Kt/v [(BUNpre−BUNpost)/BUNpre]×100, (mean±SD)	0.51±0.12	NA
Serum albumin (g/dl) (mean±SD)	4.19±0.66	NA
Hemoglobin (g/dl) (mean±SD)	10.28±2.05	NA
Cause of kidney disease, *n* (%)		
Diabetes mellitus	182 (35.5)	NA
Hypertension	213 (41.6)	NA
Glomerulonephritis	45 (8.8)	NA
Pyelonephritis	23 (4.5)	NA
Other	49 (9.6)	NA

Table 2 Patients' oral health parameters

	Haemodialysis patients (n=512)	Healthy sample (n=255)	F (p)
Decayed teeth (DT), mean (SD)	0.91 (1.93)	2.51 (2.12)	23.447 (<0.001)
Missing teeth (MT), mean (SD)	11.71 (7.68)	6.40 (4.21)	49.126 (<0.001)
Filled teeth (FT), mean (SD)	7.37 (8.02)	1.43 (1.60)	50.605 (<0.001)
Decayed, missing and filled teeth (DMFT), mean (SD)	20.06 (11.16)	10.57 (6.74)	54.506 (<0.001)
Gingival index, mean (SD)	1.59 (0.97)	1.10 (0.91)	27.816 (<0.001)
Plaque index, mean (SD)	1.92 (1.28)	1.18 (1.00)	73.719 (<0.001)
Community periodontal index (CPI)			
CPI0, *n* (%)	25 (5.5)	22 (8.6)	
CPI1, *n* (%)	88 (17.2)	30 (11.8)	
CPI2, *n* (%)	126 (24.6)	108 (42.4)	
CPI3, *n* (%)	162 (31.6)	69 (27.1)	
CPI4, *n* (%)	74 (14.5)	26 (10.2)	
CPIX, *n* (%)	34 (6.6)	NA	
CPI (mean, SD)	2.34 (1.12)	2.18 (1.05)	81.62 (<0.001)

Table 3 Percentage of participants responding sometimes, fairly often, very often or all the time to each item of Oral Health Impact Profile (OHIP-14)

	Haemodialysis patients (n=512) n (%)	Healthy sample (n=255) n (%)	Chi-square p value
Functional limitation			
Trouble pronouncing words	342 (66.8)	44 (17.3)	<0.001
Sense of taste impaired	450 (87.9)	72 (28.2)	<0.001
Pain and discomfort			
Painful aching in mouth	370 (72.3)	106 (41.6)	<0.001
Uncomfortable to eat foods	352 (68.8)	95 (37.3)	<0.001
Psychological impacts			
Been self-conscious	417 (81.4)	50 (19.6)	<0.001
Felt tense	340 (66.4)	83 (32.5)	<0.001
Difficult to relax	330 (64.5)	59 (23.1)	<0.001
Been embarrassed	426 (83.2)	71 (27.8)	<0.001
Felt life less satisfying	465 (90.8)	57 (22.4)	<0.001
Behavioural impacts			
Diet has been unsatisfactory	449 (87.7)	123 (48.2)	<0.001
Had to interrupt meals	339 (66.2)	104 (40.8)	<0.001
Been irritable with others	392 (76.6)	109 (42.7)	<0.001
Difficulty doing usual jobs	406 (79.3)	105 (41.5)	<0.001
Totally unable to function	460 (89.8)	111 (43.5)	<0.001

factors predisposing to periodontal disease and accelerating its progression are widespread in chronic renal failure patients [27]. Moreover, it was observed that a larger number of HD patients suffered from gingivitis and more dental plaque accumulation than the healthy controls. This might be due to the practice of poor oral hygiene procedures among our patients.

Periodontitis is a relatively common complication in HD patients that has been attributed to poor OHRQoL [8]. The current study with a control group investigated the impact of periodontitis and gingivitis on HD patient's OHRQoL for the first time. The results of this study were also adjusted for socio-demographic variables such as education, age, gender and family income, to avoid ambiguous interpretation.

It is evident from the past studies that ESRD is associated with poor quality of life along with chronic pain, depression and limited functional abilities [21]. In the present study, HD patients had poor scores in comparison to the control group for both the physical and mental components of SF-36 questionnaire which implies that they had poorer GHRQoL which is in accordance with a previous study from Croatia [28]. This suggests that besides physical limitations, HD patients are susceptible to mental suffering. Likewise, it has been reported that a close relationship exists between physical disorders and mental suffering, reduced vitality and lack of socialization in HD patients [29]. Though a previous study suggested [8] that oral health was not a major concern among HD patients because of the moderate impact of OHRQoL, we have observed that HD patients had poorer OHRQoL than the control group. This disparity in the findings might be attributed to age differences. In the past study, the mean age of HD patients was 46.4 years, while our patients were relatively older with a mean age of 57.7 years. As observed by Zimmer et al., age does per se affect OHRQoL [30].

The results of the current research indicated that low family income and a low level of education served as predictors of the poor OHRQoL among HD patients. Family income has been found to be related to poor oral health status across the literature [31, 32]. The association between family income and OHRQoL is not completely clear, but dental insurance may interfere with this relationship [26] and dental coverage is

Table 4 A comparison of the general health-related quality of life (SF-36) and oral health-related quality of life (OHIP-14) in study and control groups

	Haemodialysis patients (n=512) mean (SD)	Healthy sample (n=255) mean (SD)	
PCS	47.92 (9.52)	59.57 (9.52)	p<0.001
MCS	50.06 (12.34)	59.34 (8.28)	p<0.001
OHIP-14	19.10 (10.21)	9.66 (5.24)	p<0.001

PCS physical component summary, *MCS* mental component summary, *SF-36* Short Form Health Survey, *OHIP-14* Oral Health Impact Profile

Table 5 Hierarchical linear regression model depicting the factors associated with OHRQoL in haemodialysis patients

	Model 1	Model 2	Model 3	Model 4	Model 5
Socio-demographic characteristics					
Age	0.125*	0.069*	0.051*	0.040	0.038
Sex	0.097	0.039	0.025	0.022	0.024
Family income					
Poor	Ref	Ref	Ref	Ref	Ref
Moderate	−0.415*	−0.152*	−0.051	−0.016	−0.015
High	−0.924*	−0.221*	−0.129*	0.062*	−0.073*
Years of education	−0.126*	0.025	0.020	0.017	0.051*
Clinical variables					
Body mass index (BMI)		0.041*	0.031*	0.024	0.023
Diabetes mellitus					
Yes		0.117*	0.103*	0.081*	0.067*
No		Ref	Ref	Ref	Ref
Kt/v [(BUNpre−BUNpost)/BUNpre]×100		0.065*	0.079*	0.068*	0.064*
DMFT		0.132*	0.132*	0.141*	0.146*
CPI		0.193*	0.155*	0.145*	0.136*
VPI		0.087*	0.099*	0.088*	0.088*
GI		0.453*	0.373*	0.319*	0.255*
Cognitive variables					
Oral health knowledge			−0.083*	−0.128*	−0.087*
Oral health attitude			−0.134*	−0.174*	−0.212*
Oral self-care behaviours					
Dental brushing					
Regular (2 times per day)				−0.118*	−0.103*
Irregular (<2 times per day)				Ref	Ref
Dental flossing					
Regular (1 time per day)				−0.089	−0.051
Irregular (<1 time per day)				Ref	Ref
Last dentist visit (months)					
>6				Ref	Ref
<6				−0.114*	−0.094*
Smoking					
Yes				−0.217*	0.139*
No				Ref	Ref
General health-related quality of life					
PCS					−0.264*
MCS					−0.093*
R^2 change	0.518	0.098	0.03	0.05	0.04
F change	127.89*	31.087*	6.470*	29.37*	14.05*

PCS physical component summary; *MCS* mental component summary; *OHIP-14* Oral Health Impact Profile; *DMFT* decayed, missing and filled tooth index; *GI* gingival index; *CPI* community periodontal index; *VPI* visible plaque index

* $p < 0.05$

affected by both annual income as well as the level of education [26]. Educational level is also considered as an indicator of socio-economic status and is correlated significantly with family income. According to the World Health Survey 2003, Asian and African people with lower income had more oral health problems compared to those with higher income [33]. In Iran, dental insurance only covers children between 6 and 12 years and pregnant women. A recent study demonstrated that non-insured adults were more likely to report tooth extractions than those with insurance coverage [34]. Lower family income and educational status may be associated with higher dental caries and also treatment needs. These facts explain the impact of socio-economic factors on OHRQoL among HD patients.

Consistent with the previous findings [35] where socio-demographic variables and clinical factors were significantly

related to lower QoL scores, poor OHRQoL was associated with higher age, lower family income, lower educational level, BMI, Kt/v and diabetes.

The results from the multivariate analysis reinforce the assumption that a relationship exists between clinical oral health status and OHRQoL [36], as all the indices evaluated significantly influenced the OHRQoL scores. Tooth loss which is the end point of periodontal disease and dental caries has been found to have a negative impact on OHRQoL. This is in accordance with the current study where dental caries and periodontal disease significantly influenced OHRQoL [37].

Furthermore, tooth brushing, dental visits and non-smoking were related to OHRQoL in accordance with previous studies [38, 39]. OHRQoL has also been found to have an influence on the physical well-being as well as on the mental well-being of patients as expressed by PCS and MCS [30]. Similarly, we have observed that both the PCS and MCS of SF-36 exert an influence on OHRQoL.

Some potential limitations of this survey require consideration. First, despite the considerable sample size of the patients, the sample size of healthy controls was not equal to that of patients. Although we intended to recruit an equal number of healthy controls in this study, there was a high rejection rate across invited healthy controls. Moreover, our healthy controls were recruited only from Qazvin City. However, Qazvin is a city near Tehran with similar cultural characteristics and socio-economic status. Furthermore, a rigid matching was done for age and gender to improve validity of the comparisons. Therefore, the recruitment of controls from Qazvin City only would not have any significant impact on the validity of the results.

In conclusion, patients on HD had poor oral health status, OHRQoL as well as GHRQoL compared to healthy subjects. Socio-demographic variables like higher age, lower family income and lower educational level were related to poorer OHRQoL. Clinical variables (BMI, diabetes, Kt/v, DMFT, CPI, GI and VPI), oral health knowledge, attitudes and GHRQoL (both PCS and MCS) also significantly predicted OHRQoL. Regular tooth brushing, non-smoking and dental visits in the previous 6 months were also predictors for better OHRQoL among HD patients.

Due to the effect of kidney disease on oral health and subsequently OHRQoL, oral therapy in HD patients should be given prominence since poor oral health affects quality of life considerably. In addition, OHRQoL has to be considered as an important subjective measure in conjunction with GHRQoL in kidney disease patients. Consequently, condition-specific tools for quality of life measurement have to be developed for use in this population, with oral health components included in the questionnaire.

Conflict of interest The authors declare that they have no conflict of interest.

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